NASA Helps Keep the Light Burning for the Saturn Car Company

HANCOCK COUNTY, Miss. – The Saturn Electronics & Engineering, Inc. (Saturn) facility in Marks, Miss., that produces lamp assemblies was experiencing intermittent problems with its automotive under the hood lamps. After numerous testing and engineering efforts, technicians could not pin down the root of the problem. So Saturn contacted the NASA Technology Assistance Program (TAP) at Stennis Space Center.

The Marks production facility had been experiencing intermittent problems with under the hood lamp assemblies for some time. The failure rate, at 2 percent, was unacceptable. Every effort was made to identify the problem so that corrective action could be put in place. The problem was investigated and researched by Saturn's engineering department. In addition, Saturn brought in several independent testing laboratories. Other measures included examining the switch component suppliers and auditing them for compliance to the design specifications and for surface contaminants. All attempts to identify the factors responsible for the failures were inconclusive.

In an effort to get to the root of the problem, and at the recommendation of the Mississippi Department of Economic Development, Saturn contacted the NASA TAP at Stennis. The NASA Materials and Contamination Laboratory, with assistance from the Stennis Prototype Laboratory, conducted a materials evaluation study on the switch components. The laboratory findings showed the failures were caused by a build-up of carbon-based contaminants on the switch components.

The switch assembly consists of a brass capsule with an open end, a copper contact pin, a silver-plated ball, and a plastic insulator that fits into the open end of the brass capsule. When the hood of the car is opened, the silver-plated ball rolls down rails inside the brass capsule and contacts the copper pin. This configuration closes the circuit and allows current to pass through the light and illuminate the engine compartment.

All switch components remain sealed in the supplier's original packaging until they are issued to the capsule assembly room. The workers in this area perform two operations to fabricate the ball capsule assembly. First, an air-driven plunger press-fits a copper pin into the center opening of the plastic insulator. Second, a vibratory hopper drops the silver-plated balls into the brass capsules and seals the opening of the capsule after the insulator-copper pin subassembly is inserted.

Laboratory tests indicated the number of failures that occurred directly correlate with the amount of carbon-based contaminants on the surface of the silver-plated ball. Also, the copper pins of the failed switches exhibited a crater-like depression on the pin tip.

"A systemic testing approach was applied to the manufacturing process. Samples were taken at each step of the process to determine the source of the contamination," said Larry Clayton, Supervisor of the Prototype and Development Laboratory at Stennis.

"After analysis, evidence showed the contamination was originating from the hopper, where the silver balls are first entered into the system for assembly. No other forms of contamination were found during the system analysis."

NASA lab researchers determined the hopper bowl was lined with a urethane coating containing 1 percent carbon. The rotation and agitation of the silver-plated balls caused concentric rings of wear within the hopper coating. In addition, the cleaning materials used on the hopper caused a leaching effect of the coating, which also released carbon particles. These particles then lodged onto the surface of the silver-plated balls through the pressures exerted from the multiple layers of balls in the hopper. The level of carbon contaminants would vary for each ball depending on the amount of contact with the liner surface area the ball encountered – this caused intermittent failures in the final lamp assemblies at an unpredictable rate.

"Our efforts to find the source of the contamination were focused on the obvious," said Sandy Patrick, Operations Manager at the Marks facility. "In observing the methodology and approaches taken by the Stennis Team, we learned a tremendous amount about complex problem-solving."

NASA recommended that Saturn remove the liner coating from the hopper bowl and reduce the load size of silver-plated balls placed in the hopper. Fewer balls in the hopper bowl will reduce surface-wear due to less pressure exerted on the balls at the bottom of the hopper.

"Upon receiving the recommendations from the Stennis Team, we stripped the coating from the hopper bowl. The positive results were immediate," Patrick said.

Saturn Electronics & Engineering, Inc., is a minority-owned provider of contract manufacturing services to a diverse global marketplace. Saturn operates manufacturing facilities globally serving the North American, European, and Asian markets. Saturn's production facility in Marks, Mississippi, produces more than 1,000,000 lamps and switches monthly.

"Since the NASA recommendations were implemented, our internal failure rate for intermittency has dropped to less than .02 percent. Most importantly, we restored our high-level of customer satisfaction. Stennis provided an invaluable service to our business," Patrick said.

Both NASA and Saturn were pleased with the results from this technical assistance project. The Technology Assistance Program at Stennis makes available to the public NASA technical expertise and access to lab facilities. This project provided both services with a positive outcome.

"The Saturn project is a prime example of how NASA technology and expertise can benefit the public," said Kirk V. Sharp, Manager of the Office of Technology Transfer at Stennis. "The results of such collaborations can include creation of jobs, increased profits and enhanced economic competitiveness for the United States."

If you are experiencing technology related problems and you believe that your company is eligible and would benefit from this NASA assistance, contact the Stennis Space Center Technical Assistance Program at (228) 688-1929, or visit the web and complete an on-line Technology Assistance Request form at http://technology.ssc.nasa.gov. Or you can download the form and fax it in to the program at (228) 688-2408.

SUCCESS STORY CRITERIA NAME: Saturn Electronics and Engineering, Inc.	
Revenue Generation	X
Jobs Created or Saved	X
Cost Savings/Avoidance	
SBIR/STTR sales of product, services to the private sector	
SBIR/STTR Phase III contracts within the Federal Govt.	
New or Improved products/services	
Quality of life improvement	
Private Investment	

NASA Provides Assistance to Saturn Car Company

Saturn Electronics & Engineering, Inc., Marks, MS

Intermittent Under-hood Lamp Problems

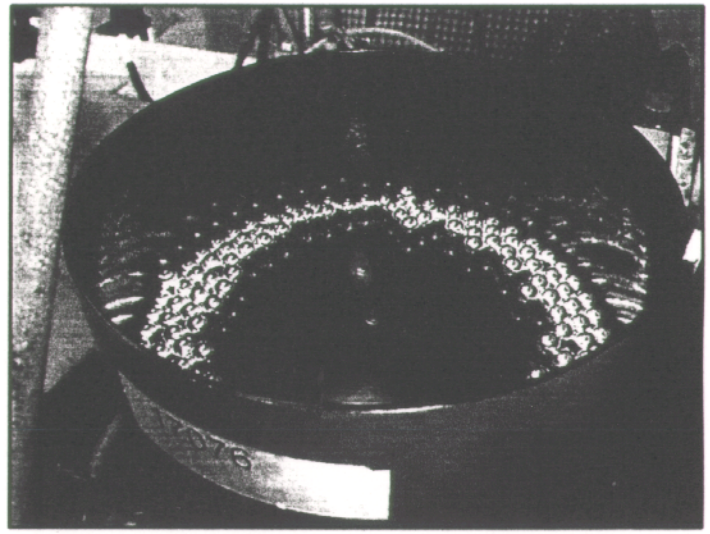
- NASA provided technology assistance to help a division of the Saturn Car Company identify the cause of intermittent failures with under the hood lamps.

Accomplishments

- NASA assistance decreased the failure rate from 2 percent to .02 percent.
- The drop on failures restored high-level of customer satisfaction.
- Identification and repair of the under-hood lamp problems continued a strong contractual obligation with Chrysler Corp.
- Through collaborations such as these, jobs will be saved, company successes will continue and economic competitiveness for the United States will result.

Assistance Provided

- Laboratory tests indicated the problems were caused by a build-up of carbon-based contaminants on the switch components – namely the silver-plated balls.
- NASA identified that in the assembly process, the hopper bowl that holds the silver-plated balls was lined with a urethane coating containing 1 percent carbon.
- Tests identified that cleaning products used on the hopper released carbon particles.
- Rotation and agitation of the balls caused wear within the hopper, contaminating the balls at various levels depending on the amount of contact the balls encountered with the liner surface.
- Saturn stripped the coating from the hopper and reduced the load size of silver balls in the hopper.



Cleaning materials and concentric wear of silver balls caused a leaching effect of the carbon-based liner within the hopper, thus causing a carbon build-up on the ball bearings and intermittent failures in the under-hood lamps.

Government/Science Facilities Used

- NASA Utilized the NASA Materials and Contamination Laboratory and the Stennis Prototype Laboratory, both at Stennis Space Center.

NASA Stennis Space Center
Sept. 13, 2001
Success Story #2400492

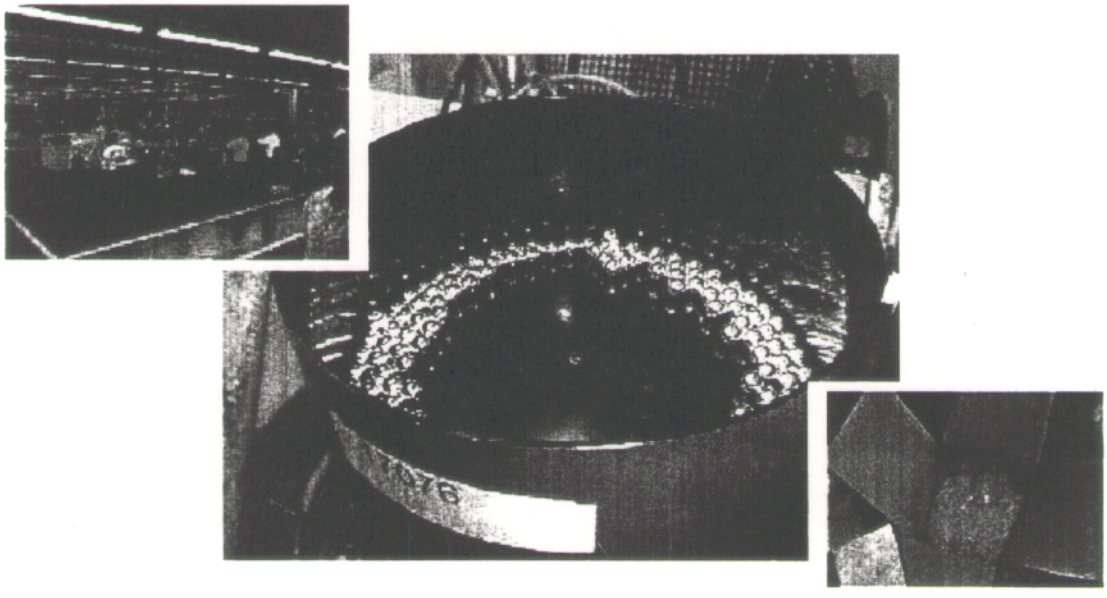
Points of Contact:
NASA Office of Technology Transfer, (228) 688-1929
Saturn Electronics & Engineering, Inc., (252) 977-1075

NASA Office of Technology Transfer

John C. Stennis Space Center

SUCCESSFUL TECHNOLOGY ASSISTANCE

NASA Helps Saturn Car Company with Hood Lamp Problem



NASA identified the urethane coating on the hopper, center, contained 1 percent carbon that created buildup on the ball bearings, right, resulting in lamp failures.

The National Aeronautics and Space Administration (NASA) Technology Assistance Program (TAP) at Stennis Space Center provided assistance to Saturn Electronics & Engineering, Inc., to solve an intermittent problem with its automotive under-hood lamps. Saturn's production facility in Marks, Mississippi, produces more than 1,000,000 lamps and switches monthly. Through the NASA Materials and Contamination Laboratory and Stennis Prototype Laboratory, NASA was able to identify the problem, make recommendations, and dropped the failure rate to less than .02 percent.

Saturn requests NASA assistance

The Marks production facility had been experiencing intermittent problems with under-hood lamp assemblies for some time. The failure rate, at 2 percent, was unacceptable. Every effort was made to identify the problem so that corrective action could be put in place. The problem was investigated and researched by Saturn's engineering department. In addition, Saturn brought in several independent testing laboratories. Other measures included examining the switch component suppliers and auditing them for compliance to the design specifications and for surface contaminants. All attempts to identifying the factors responsible for the failures were inconclusive.

HOT Points

- **Failure rate dropped from 2 percent to .02 percent**
- **Restored high-level of customer satisfaction**
- **Saved company contract with Chrysler Corp.**
- **Saved more than 200 jobs**

In an effort to get to the root of the problem, and at the recommendation of the Mississippi Department of Economic Development, Saturn contacted the NASA TAP at Stennis. The NASA Materials and Contamination Laboratory, with assistance from the Stennis Prototype Laboratory, conducted a materials evaluation study on the switch components. The laboratory findings showed the failures were caused by a build-up of carbon-based contaminants on the switch components.

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Both NASA and Saturn were pleased with the results from this technical assistance project. The Technology Assistance Program at Stennis offers certain services to the public in the form of unique NASA expertise and access to lab facilities. This project provided both services with a positive outcome.

"The Saturn project is a prime example of how NASA technology and expertise can benefit the public," said Kirk V. Sharp, Manager of the Office of Technology Transfer at Stennis. "The results of such collaborations can include creation of jobs, increased profits and enhanced economic competitiveness for the United States."

Points of Contact

- **Saturn Electronics & Engineering, Inc., a division of the Saturn Car Company**
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